



A WHITE PAPER

THE DIGITAL WORLD OF YOUNG CHILDREN: IMPACT ON EMERGENT LITERACY

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Introduction

Young children throughout the world are surrounded by opportunities to develop and use emergent literacy skills—listening, speaking, reading, and writing. These opportunities are as diverse as the language, cultures, and peoples they represent and acknowledge the many linguistic, cognitive, and socio-emotional resources available to young children in their daily lives. Opportunities found in every culture of the world include watching, listening, and using language (Feldman, 1980). Their quality and quantity play a critical role in emergent literacy skills development, which lays the foundation for adolescent and adult language use and thinking as documented in a large and robust international research base (Bracken & Fischel, 2008; DeTemple, 2001; Dickinson & Newman, 2006; Hart & Risley, 1995; Newman & Dickinson, 2004; Purcell-Gates & Dahl, 1991; Scarborough, 1998; Senechal, Quelette, & Rodney, 2006; Snow, Burns, & Griffin, 1998; van Kleeck, 2003; Whitehurst & Lonigan, 1998).

At almost any opportunity, three-, four-, and five-year-old children will spontaneously engage in emergent literacy activities. In today's world they have multiple opportunities to observe, explore, play with, and learn from digital media—television, DVDs, MP3s, Touch/iPhones, computers, video games, cell phones, smart toys, and the like (Crichter, 2008; Drotner & Livingston 2008; Hasebrink, Livingstone, Haddon, & Olafsson, 2009; Linebarger & Piotrowski, 2009). These learning opportunities come at a particularly critical period in their development. Their brains are remarkably supple as neurons make and reinforce connections with almost every experience. This is a time of discovery and exploration during which they are developing a natural sense of wonder and joy about their world, as well as a time when their emergent literacy skills are beginning to develop based on their experiences and neural circuitry.

Until recently, the surge in young children's digital-media-based learning opportunities has drawn scant attention. That situation is now changing (Glaubke, 2007; Lemish, 2008; Weigel, James, & Gardner, 2009; for exception, see Lankshear & Knobel, 2003). The Nielsen Company in the U.S. now gathers data that measures digital media use by children from two to five years of age (who spend 32 hours a week in front of a videogame, TV, DVD, DVR, or VCR screen; McDonough, 2009). In the last year, a comprehensive governmental review from the United Kingdom and at least four separate volumes have focused on digital media and children, with one focused solely on literacy (Byron Review, 2008; Calvert & Wilson, 2008; Coiro, Knobel, Lankshear & Leu, 2008; Drotner & Livingston, 2008; Willoughby & Wood, 2008). Despite this interest, however, it is difficult to gauge what is actually happening,

because the little that is known about the effects of digital media on emergent literacy skills development comes from educational television and computer studies, as well as from a few studies of other media and surveys (e.g., U.S., Early Childhood Longitudinal Study; The National Institute of Child Health and Human Development Study of Early Child Care; National Health and Nutrition Examination Survey). This lack of empirical research has been noted, for example, by McPake, Stephen, and Plowman (2007), who found “little research into early technology experiences of children aged three to five, [and] how these experiences might relate to emerging literacies, or the implications for subsequent development” (p. 4; see also Anderson & Hansen, 2009).

While almost any exposure to people and language presents a potential emergent literacy learning opportunity, these opportunities can exist through “intentional” activities such as educational television (e.g., *Sesame Street*) or perhaps more commonly through “non-intentional” activities that have no expressed learning objectives or curriculum. Young children may simply be watching, listening, and talking to others who are using digital media like *Pokémon* or cell phones. These less-than-classical learning opportunities exist because adolescents and adults are now using a variety of digital media for communication and entertainment and because young children are inextricably intertwined in those activities (Bowman, Donovan, & Burns, 2001; Byron Review, 2008; Druin, 2009; Guernsey, 2007; Marsh, 2004; Marsh & Millard, 2000; Marsh, Brooks, Hughes, Ritchie, Roberts, & Wright, 2005; McPake, Stephen & Plowman, 2007; Pahl & Roswell, 2006; Palfrey & Gasser, 2008; Shuler, 2007; 2009; Specht, 2009; Stephen, McPake, Plowman, & Berch-Heyman, 2008).

In this way, learning happens automatically and naturally for these children as they hear and see language and interact with those around them (Weigel, James, & Gardner, 2009). As Bandura (2001) cogently noted about non-intentional learning opportunities, “learning occurs either directly or unintentionally from models in one’s immediate environment. However, a vast amount of information about human values, styles of thinking, and behavior patterns is gained from the extensive modeling in the symbolic environment of the mass media” (pp. 270-271; Cooper, 2005). For young children, this means that digital media—including ubiquitous cell phone and video games—can affect emergent literacy skills development.

This white paper takes a first look at the everyday world of digital tools and media in the lives of three- to five-year-old children, with a particular focus on non-intentional learning opportunities in developing and least-developed nations. It begins a discussion about how digital media learning opportunities, including non-intentional opportunities such as cell phones and video games, when combined with intentional learning opportunities such as educational television or computers, may be affecting emergent literacy skills development (Anderson & Pempek, 2005). An understanding of this phenomenon is important, because when new digital tools and media, as well as novel combinations of old and new media, become available and commonplace, “the media that children use and create [will be] integral to their growing sense of themselves, of the world, and of how they should interact with it” (Center for Media and Child Health at Children’s Hospital, 2008, np). Digital media may be transforming the language and cultural practices that enable the development of emergent literacy skills. A new generation of young children is experiencing a new kind of interconnectedness in the language they see, hear, and use. For example, a young child may observe a sister talking with a friend, texting (writing) the friend, and then reading the text. Young children are increasingly surrounded by language sculpted by digital media, and this process has implications for the way their neural circuitry learns to speak, listen, read, and write (Small & Vorgan, 2008).

This white paper operationally defines “digital media” as both the technology tools and the media that infuse life into the tools. This definition acknowledges a continuum of interactivity for digital media bracketed by young children being passive observers or listeners on one end and active participants on the other. Interactivity would be judged by the extent to which young children have control over content or communication through responsive interaction in a verbal or nonverbal fashion (Calvert et al., 2005; Glaubke, 2007; Johnson, Bruner & Kumar, 2006).

Developed Nations

At this point in the 21st century, most young children in developed nations live in media-saturated homes, schools, and communities (Alexander, 2009; Byron Review, 2008; James & Pollard, 2010; Kline, 2004; PEW Research Center,

2009; Roberts & Foehr, 2008, Shuler, 2009; Vandewater & Lee, 2009). For young children in these countries the following story can be reality.

It is an ordinary school day, as a group of kindergarten students gets off the bus. Suddenly, one of them spots an unusual bird high up in a tree. Running inside, they tell their teachers in excited voices that there is an owl in the tree. Armed with cameras, they run back outside with their teacher, who identifies the bird as a red-tailed hawk as students capture it digitally. Discussing the bird on their way back to the classroom, one student asks, “Can I Google red-tailed hawk?” He does so, sharing his findings with his classmates via large-screen projector. Using multimedia software, each student creates a small piece of illustrated writing about the hawk, some emailing what they have created to their parents. At the students’ request, the teacher organizes the class to create a torn-paper collage of the red-tailed hawk, which is framed and displayed prominently in the classroom (van ‘t Hooft, Swan, Cook, & Lin, 2007, p. 3).

Developed nations today enjoy almost universal access to television, as well as widespread access to computers, the Internet, cell phones, video games, DVDs, mobile music/video players, podcasts, e-books, digitized toys, and more. In the words of Warren Buckleitner (2008), young children are “gadgeted,” and opportunities to learn from digital media abound. A Kaiser Family Foundation survey study, *Zero to six: Electronic media in the lives of infants and preschoolers* (2003), documented the degree to which young children are immersed in digital media, and a follow-up survey study, *The media family: Electronic media in the lives of infants, toddlers, preschoolers and their parents* (2006), enlarged the scope of the earlier data and confirmed the findings of its predecessor.

Young children are not only immersed in a sea of digital media—up to two hours per day—they are also using it. Many have computers and can access age-appropriate web sites (e.g., Webkinz Jr., JumpStart World, MyNoggin). Several computers designed for preschoolers are currently available, including PeeWeePC, 2goE10, Disney Netpal by ASUS, Intel Classmate (see Appendix E), and OLPC’s XO (see Appendix F), offering USB ports, wireless capacities, and fully functional operating systems. All are designed to be user-friendly for young children. All but Aspire One have touch screens (for a more comprehensive evaluation, see *Children Technology Review*, May 2009). Clearly, many young children are developing digital media fluency. Christine Glaubke, in a 2007 review of the literature on the effects of interactive media on young children, reported that 64 percent of three- to five-year-old children can use a mouse to point and click, 56 percent have used a computer by themselves, and 37 percent can turn the computer on by themselves. In addition, most children have acquired these skills by three and one-half years of age (citing Rideout et al., 2003; Calvert et al., 2005). This early proficiency

with media has prompted Mark Prensky (2006) to label our youngest learners “digital natives” and the rest of us “digital immigrants.”

In developed nations, immersion in digital media is clearly affecting emergent literacy skills development (Alberto-Andres, 2004; Buckingham & Scanlon, 2003; Calvert, Jordan, & Cocking, 2002; Cooper, 2005; Drotner & Livingston, 2008; Hartmann & Brougere, 2004; Saloman, 1979). In addition, it is leading to substantial learning outside formal preschool opportunities. As Rideout et al. (2003) have noted, there is a “potentially revolutionary phenomenon in American society: the immersion of our very youngest children, from a few months to a few years old, in the world of electronic and interactive media. The impact that this level of media exposure has on children’s development is unknown, but one thing is certain: it is an issue that demands immediate attention from parents, educators, researchers and health professionals” (p. 12). Vandewater et al. (2007) reached the same conclusion, noted the striking lack of empirical research on this phenomenon, and remarked that changes resulting from the move to digital media are happening in “ways unknown in previous generations” (Vandewater & Lee, 2009, p. 1154). Even without empirically based knowledge, it is clear that most young children in developed nations live in a world of multiple emergent literacy opportunities and a near surfeit of digital media, and that their contemporaries in other nations are seeing those opportunities become more and more commonplace by the day.

Developing and Least-Developed Nations

While children in developing and least-developed nations may not be immersed in digital media to the same extent as their counterparts in developed nations, their digital learning opportunities are nonetheless steadily increasing (United Nations, 2008). From the one-rupee video game rooms in the Dharavi slums of Mumbai, to the cybercafes of Condega in the mountains of rural Nicaragua, to the Save the Children/CESVI Internet connections in the École Medina Gounass shantytown of Dakar, to the ever-present cell phones in the villa miserias of Buenos Aires or favelas of Rio de Janeiro, digital media are widely present in the emergent literacy lives of millions of young children. This explosion is due primarily to the rapidly increasing availability of low-cost, easily available digital media (see Appendices B, C).

Although, as noted earlier, research on the impact of digital media on young children in developing and least-developed nations is almost non-existent (Rideout et al., 2003; Tierney, 2009; Trucano, 2009; Vandewater et al., 2007), discussions about the influence of digital media in general on these children have begun, as evidenced by chapters in the *International Handbook of Children, Media and Culture* (Drotner & Livingston, 2008). It appears that the effects on young children may differ across languages and cultures. According to Oakes (2009), the context in which children encounter digital media can “shape, mediate and/or

modify effects” (p. 1142). And according to Lemish (2008), it is “clear that the interactions of the child’s individual traits with characteristics of the family...as well as the macro characteristics of society, are central in forming and understanding media-related experiences and outcomes” (p. 164). Since cultural and language norms in many developing and least-developed nations differ markedly from Western norms, it is possible that digital media may affect emergent literacy skills in these nations in ways that cannot be foreseen.

Language and culture may not always be the major influences on how digital media affects young children. Many families around the world face enormous day-to-day challenges, such as basic safety, nutrition and health, attitudes toward formal education, and even the availability of formal schooling opportunities (UNICEF, 2009). However, even in the face of such challenges, it appears that the use of digital media is likely to become more widespread in the lives of these families and their children. According to the Cooney Center report on mobile technologies, *Pockets of Potential* (2009), “more than half of the world’s population owns a cell phone” (Shuler, 2009, p. 4; see also Specht, 2009), and, as documented on the MIT Next Billion Network web site (www.nextbillion.mit.edu), within the next three years another billion people will begin to use cell phones, continuing the fastest new technology adoption in history. What does this mean for the young children of the world? Clearly, cell phones will lead the technology onslaught, followed probably by other mobile technologies such as handheld iPods, phone devices, and gaming platforms. Shuler (2009) has even suggested that mobile technologies will reach all children of the world, “because of their relatively low cost and accessibility in low-income communities, handheld devices can help advance digital equity, reaching and inspiring populations ‘at the edges’” (p. 5), an opinion that appears to be borne out by the latest trends and user statistics.

Cell phone growth has been documented in the Cooney Center report *Pockets of Potential* (2009; see, United Nations, e-Government survey, 2008) and in the 2008 *International Telecommunications Union Annual Report*, which records that there are four billion cell phone users in the world—nearly one per adult living today—and the number is growing. Internet usage in Africa is now 67.3 million people, up from four million in 2000. Internet usage in Asia in the same period increased from 114 to 738 million, in Europe from 105 to 418 million, in the Middle East from three to 57.4 million, in Latin America/Caribbean from 18 to 179 million; and in Oceania/Australia from seven to 21 million (September 30, 2009; Internet World Stats, Miniwatts Marketing Group). Clearly, with over four billion cell phone users and 1.7 billion Internet users around the world, many young children are watching, listening—and learning.

Related Research

Several organizations, including non-profits, foundations, university centers, corporations, and non-governmental entities (NGOs), have taken an interest in digital tools and media with respect to young children in developed nations, and some are beginning to show an interest in their impact on children in developing and least-developed nations. These organizations include the Henry J. Kaiser Family Foundation; Joan Ganz Cooney Center at Sesame Workshop; John D. and Catherine T. MacArthur Foundation; Esmée Fairbairn Foundation; International Clearinghouse on Children, Youth and Media; the Pearson Foundation; and the BBC World Service Trust. A sample of these efforts is reviewed below.

Henry J. Kaiser Family Foundation (USA)

Historically, this foundation has supported projects in the areas of child and family health. In the last few years, however, the foundation has begun to support research on the effects of digital media on young children. Although they have focused on developed nations, several reports since 2003 are of interest.

Zero to six: Electronic media in the lives of infants and preschoolers (Rideout et al., 2003) examines data on the role of media in the lives of American children aged six months to six years and is one of the earliest reports to include children under two years of age. The findings indicated immersion in digital media by preschool children, with 70 percent of all four- to six-year-olds having used a computer (11% under two) and spending an average of just over one hour per day in computer use (two hours for all screen media). Fifty-six percent have used the computer by themselves (27% of zero- to three-year-olds); 64 percent can use a mouse to point and click; and 40 percent can load a CD-ROM by themselves (p. 5). The report also includes usage statistics for music, video, video games, reading, and attitudes among children and parents toward all these technologies.

The media family: Electronic media in the lives of infants, toddlers, preschoolers and their parents (Rideout et al., 2006) updated and expanded the scope of data in the earlier report and included a discussion of parental media usage and attitudes about children's use, as well as demographic and gender differences. Cell phone usage by children in this age group was not included, although cell phones are now being recognized as perhaps the next biggest digital medium for learning (see below).

In addition, *Generation M: Media in the lives of 8-18 year-olds* (Roberts et al., 2005) and the newly released *Generation M²: Media in the lives of 8-18 year-olds* (Rideout, Foehr, & Roberts, 2010) have updated earlier survey data about the use of digital media and children that appeared in *Kids and media at the new millennium* (1999).

Although these studies did not focus on young children, they documented the digital media immersion in American families.

Joan Ganz Cooney Center at Sesame Workshop (USA)

The Joan Ganz Cooney Center supports research on digital media to advance children's learning.

The power of pow! Wham!: Children, digital media & our nation's future (Shore, 2007) reviewed the challenges facing practitioners and researchers in today's educational landscape where children are immersed in digital media opportunities. The report covers children in the elementary school age group, interviewing 60 leaders from a variety of relevant fields and concluding that there are broad challenges facing digital media and learning. According to author Rima Shore, "most of the important questions about the impact of interactive digital media on children's development have yet to be answered," (p. 7, Executive Summary) and "sustained research within and across diverse disciplines is needed to shed light on the potential benefits and risks of digital media for children of different ages, backgrounds, and learning profiles" (p. 9).

D is for Digital: An analysis of the children's interactive media environment with a focus on mass marketed products that promote learning (Shuler, 2007) analyzed the interactive media environment of children ages 3-11 in the U.S. with a focus on mass-market informal learning products. "It examines key factors influencing the environment, scans the current state of the market, and makes recommendations to inform research, production and policy to expand quality educational media for children" (p. 6). The report confirmed other data that show increased and earlier use of digital media by children, as well as noting that parents "accept that children have become digital media consumers, with a majority believing that video games are a positive part of their children's lives" (p. 7). The report makes several recommendations on how to harness digital media in support of children's

learning. It recommends the development of educational video games and eWeb/toy hybrids, capitalizing on the popularity of virtual worlds and creating standards to evaluate products that are marketed as educational (p. 8-9, paraphrase).

Pockets of potential: Using mobile technologies to promote children's learning (Shuler, 2009) chronicles the use of mobile technologies by children across the world and offers a list of opportunities, challenges, and goals for their effective use as learning tools, both inside and outside of formal school settings. The report notes five significant challenges—negative aspects of mobile learning, cultural norms and attitudes, a lack of theory on mobile learning, differentiated access and technology, and limiting physical attributes of the technologies. The report cites a number of countries where mobile resources have been used for learning (United Kingdom, Scotland, Taiwan, Singapore, Kenya, South Africa). It is also noteworthy that Sesame Street Workshop, with funding from the U.S. Ready to Learn Initiative, studied family use of cell phones to help three- and four-year-old children learn letters and the alphabet song. The study found positive results both in terms of learning and parental opinions (*PBS Ready to Learn: Learning Letters with Elmo*, WestEd, 2006).

In addition, two 2009 reports, *Game changer: Investing in digital play to advance children's learning and health* (Thai et al., 2009) and *The digital promise: Transforming learning with innovative uses of technology* (Wellings & Levine, 2009), focused on using digital play to advance children's learning about health as well as emerging uses of digital media to enhance learning.

MacArthur Foundation, Center on Media and Learning (USA)

The John D. and Catherine T. MacArthur Foundation is one of the most prolific private providers of educational grants in the United States. The Foundation launched a five-year, US\$50 million digital media and learning initiative in 2006 to help determine how digital media are changing the way young people learn, play, socialize, and participate in civil life. To date, however, the initiative and other foundation efforts have not focused on early childhood or developing or least-developed nations. Nevertheless, three reports are of interest.

Confronting the challenges of participatory culture: Media education for the 21st century (Jenkins et al., 2006) addressed the issue of how youth can meet the digital literacy challenges of this century. *Living and learning with new media: Summary of findings from the Digital Youth Project* (Ito et al., 2008) summarized one of the foundation's digital media and learning initiatives, the Digital Youth Project, that began in 2006. In this three-year survey study, researchers found that older children and adolescents used digital media to extend friendships and interests as well as for self-directed and peer learning. In the third study, *Teens, video games and civics* (Lenhart et

al., 2008), the foundation teamed with the PEW Internet Project to document the widespread and diverse use of video games and the often overlooked advantages of gaming such as increased social engagement. The foundation has also partnered with Edutopia (Digital Generation Project, 2009) to document how digital media changed learning for ten young people, and supported the GoodPlay Project at Harvard University, which studies ethical and socially productive ways young people ages 15-25 use online games, social networking, and other online communities. The foundation also collaborates with the Cooney Center on The Global Kids Digital Media Initiative, a series of interrelated programs designed to support teenagers in thinking critically about the role of digital media in their lives, promote constructive use of new media forms, and document experiences. The initiative uses contests, online dialogues, a virtual world, podcasts, a blog, and other venues to gather valuable input from young people about their relationship with emerging media (www.globalkids.org, np). While the foundation has not sponsored studies focused solely on very young children, these efforts do provide valuable information about the digital media environments that surround preschoolers as they develop emergent literacy skills.

Esmée Fairbairn Foundation (UK)

The Esmée Fairbairn Foundation is one of the largest grant-making foundations in the United Kingdom, supporting cultural life, education, and the natural environment and helping disadvantaged people participate more fully in society. The Digital Beginnings Project (Marsh et al., 2005, co-funded by BBC Worldwide) explored young children's use of popular culture, media, and new technologies in the home from September 2004 to July 2005. This report was one of the earliest to recognize the degree that digital media other than television has influenced British children under 10 years old.

International Clearinghouse on Children, Youth and Media (Sweden)

Financed by the Swedish government and UNESCO and maintained by NORDICOM, Göteborg University, the Clearinghouse's web site is a must-bookmark for anyone interested in research on children and media. The goal is to increase awareness and knowledge about children, youth, and media, offering perhaps the most complete repository of studies available and a searchable archive of newsletters covering developed, developing, and least-developed nations.

Pearson Foundation (USA/UK)

The Pearson Foundation has long been a major player in efforts to improve literacy among young children. The foundation sponsors classroom and community support programs around the world through its philanthropic

efforts, including literacy programs for young people and professional development training for educators throughout developing and least developed nations. These programs include the Foundation's own We Give Books, Family Book Nights, and Literacy Alliance programs, as well as innovative partnerships with non-profits including Jumpstart, Booktime, Room to Read, and the Jane Goodall Institute.

Since 2005, the Pearson Foundation has expanded its literacy efforts to include digital literacy as well. Together with Nokia, the Pearson Foundation supports the Mobile Learning Institute. The program, which has served more than 25,000 young people and educators in the United States since its inception, has recently expanded to provide MLI Leadership Summits for educators and administrators in Africa and Latin America. Its *21st Century Education* film series features short profiles of innovative educators in today's classrooms. For example, one film featured the use of PDA-type computers in elementary school science classrooms (*Go Know!*, Elliot Soloway). Together with Nokia, the Pearson Foundation and local implementation partners including the International Youth Foundation, the U.S. Agency for International Development, and the United Nations Development Programme support *Bridgeit* projects in the Philippines and Tanzania, an effort that combines mobile phones and existing wireless services to deliver educational programs to teachers and children who otherwise would not have access to them. Together with the One Laptop per Child initiative, the Pearson Foundation also introduced a country-wide digital literacy program in Uruguay in 2009.

BBC World Service Trust (UK)

Active in more than 40 developing and least-developed nations for the last ten years, the BBC World Service Trust demonstrates that digital media can reach children and families living in poverty. In Afghanistan, the series *Pedlar's Bag* (with picture books) encourages learning and basic literacy for five- to nine-year-olds. While only a few of the trust's efforts are targeted directly at young children, many are targeted at families, with non-intentional learning effects on children and emergent literacy skills development. The BBC World Service Trust is an independently funded charity of BBC World, whose 2008 TV series *First Steps* documented early child development in Brazil, Moldova, Uganda, and the Philippines (archived online at <http://www.rockhopper.tv>).

Other Organizations

The Aga Khan Development Network (AKDN) works on improving education for children in developing and least-developed nations. The AKDN Saudi Arabia and its Education Services Agency (AKES) have focused their efforts on education for young children in developing and least-developed nations (see Appendix D).

Effects: Tools, Applications, and Research

Television

In the last few years, most families in developed and developing nations have begun to gain access to television channels and programming, including children's television (see Appendix C). For example, according to the China Media Monitor (<http://www.cmmintelligence.com>), the penetration rate for television in Chinese households is about 97 percent, and the average number of channels received by each household is 36. These channels are available from satellite, cable, terrestrial (free-to-air), and Internet sources. Many programs besides cartoons are available for children. A Google search reveals that children's programs and channels are available in all the major languages of the world. For example, in Qatar, the Al Jazeera Children's Channel launched *Baraem*, "the first pre-school Arabic television for children between the age of three and six years old" (Al Jazeera, 2009, n.p.). Television is clearly part of the lives of hundreds of millions of young children around the world.

The most important research on the impact of television on emergent literacy skills development has come from *Sesame Street*, which is now available in multiple languages and 125 nations. *Sesame Street* uses a combination of puppets, animation, and live actors to teach emergent literacy skills, including letter and word recognition and speaking, listening, and writing skills. The program encourages parents and older siblings to watch along with younger children and become active partners in learning. A sampling of *Sesame Street* programs from around the world includes *Galli Galli Sim Sim* (India), *Vila Sésamo* (Brazil), *Jalan Sesama* (Indonesia), *Sisimpur* (Bangladesh), *Plaza Sésamo* (Mexico, Spanish Latin America), *Alam Simsim* (Egypt), *Shara'a Simsim* (Palestinian Territory), *Ulitsa Sezam* (Russia), *Rruga Sesam* (Albania), *Ulica Sezam* (Serbia), *Hikayat Simsim* (Jordan), and *Takalani Sesame* (South Africa). The research from *Sesame Street*, as well as from other educational programs like *Blue's Clues*, *Between the Lions*, *Zoboomafoo*, and *Super Why?*, reports positive effects in the short and long term for cognitive, linguistic, and socio-emotional skills, depending on variables such as age, content, program design, viewing context, and socioeconomic status (Close, 2004; Krikorian, Wartella, & Anderson, 2008; Linebarger & Piotrowski, 2009; Mares & Woodard, 2005; Pasnik, Strother, Schindel, Penuel, & Llorente, 2007; Penuel, Pasnik, Bates, Townsend, Gallagher, Llorente, & Hupert, 2009). For example, Krikorian, Wartella and Anderson (2008) noted that "there is strong evidence that children older than two learn from educational media, and there is moderate evidence that exposure to educational television during the preschool years is positively linked with various measures of academic achievement even ten years later" (p. 53). They also comment that, "although the finding is particularly true for television, it is likely to be important for interactive media as well" (p. 49). Additionally, Rideout, Vandewater, and Wartella (2003) confirmed that "many parents see media as an important educational tool...and parents clearly perceive that their children's TV watching

has a direct effect on their behavior, and are more likely to see positive rather than negative behaviors being copied" (p. 12).

Mixed results are to be found in non-educational, general entertainment viewing studies. For example, Gentzkow and Shapiro (2008) reported in the *Quarterly Journal of Economics* that general television viewing by young children had a positive effect on adolescent achievement, especially for at-risk children. However, concerns about the effects of general TV viewing on young children have also been noted. Mistry, Minkovitz, Strobino, and Borzekowski (2007) reported in *Pediatrics* that sustained television viewing was associated with more behavioral problems over time for preschool children (see also Common Sense Media, 2008; Villani, 2001). With specific regard to emergent literacy, Ennemoser & Schneider (2007) reported that TV viewing and reading literacy are influenced by program content. In the case of entertainment TV, the influence is negative but in the case of educational TV generally positive. These findings confirm the earlier positive results of Linebarger et al. (2004) with regard to the relationship between educational television, young children, and emergent literacy skill development (for review, see Pasnik, Strother, Schindel, Penuel, & Llorente, 2007).

A recent development is the practice of linking educational television programs to affiliate web sites and podcasts. For example, *Sesame Street* is linked to a web site at PBSkids.org, which links in turn to an additional 38 children's educational programs, including *Jay Jay the Jet Plane*, *Barney & Friends*, *Sid the Science Kid*, and *Super Why?* Extending the media reach of *Sesame Street*, program characters now have their own podcasts. Although no empirical studies have examined the effects of television and other forms of media on young children, these effects have not gone unnoticed by researchers. A few years ago, Seiter (2004) suggested that television viewing could be a transitory activity that moves children to more interactive media opportunities such as those available on the Internet—and that seems to be happening.

Computers

The first computers in classrooms date back to the late 1960s and early 1970s. However, applications aimed directly at young children and emergent literacy did not start appearing until the early 1990s (for discussions, see Alexander, 2009; Bergen, 2004; Blanchard, 1999; Blanchard & Mason, 1987; Blanchard, Mason & Daniel, 1987; Buckingham, 2000; Clements, 1997; Coiro, Knobel, Lankshear & Leu, 2008; Critcher, 2008; Guernsey, 2007; Haugland, 2000; Haugland & Wright, 1997; Heft & Swaminathan, 2002; Hitchcock, & Noonan, 2000; Labbo & Kuhn, 2000; Labbo, Sprague, Montero, & Font, 2000; Mason, Blanchard & Daniels 1983; Mason & Blanchard, 1979; Prout, 2008; Savage & Pompey, 2008; Seger & Verhoeven, 2002; Shore, 2007; Straker, Pollock, & Maslen, 2009; for review of emergent literacy, see Torgerson, 2007;

Torgerson, & Zhu, 2003; Waxman, Lin, & Micjko, 2003; for review of computer-assisted instruction for beginning readers, see Blok, Oosterdam, Otter & Overmaat, 2002; for review of computers, young children and literacy, see Hisrich & Blanchard, 2009).

Over a decade ago, the National Association for the Education of Young Children (NAEYC, 1996) endorsed the use of computers in its position paper “Technology and Young Children—Ages Three Through Eight,” with the caveat that the programs be developmentally appropriate and integrated into classroom activities. However, the Alliance for Childhood, in its publication *Fool’s gold: A critical look at computers in childhood* (2000; for response, see Clements & Sarama, 2003), suggested problems in emergent literacy skills development due in part to poor concentration, attention deficits, impoverished language, ease of distractibility, and lack of creativity and imagination (Palmer, 2006). Despite the warning, some of today’s early childhood computer programs aimed at emergent literacy seem to help children develop these skills. For example, Li, Atkins, and Stanton (2006) reported success with young children using low-cost, readily available computers and software programs such as Bailey’s Book House and Dr. Seuss’s ABC.

Currently there is no shortage of educational programming in the major languages of the world. For example, the English Knowledge Adventure Jump Start series contains games to help children build basic emergent literacy skills. Brain Play uses characters from Scholastic books to engage children in learning activities through games. Living Books offers stories and learning activities based on children’s literature titles such as *Green Eggs and Ham*. Pearson Software features play and fun in the Curious George Learns Phonics and Curious George – Preschool Learning Games Series. Clicker 5 from Crick Software features a multi-media writing tool (with speech support in several languages) that supports emergent literacy skills development (Karemaker, Pitchford, & O’Malley, 2010; McKenney & Voogt, 2009). For a more complete listing, see *Children’s Technology Review* (English).

Internet

One of the first researchers to write about the possible effects of the Internet on literacy development was Don Leu (Coiro, Knobel, Lankshear, & Leu, 2008). He and his colleagues initiated discussions on intentional and non-intentional learning opportunities available on the Internet. Although these discussions have not focused on emergent literacy per se, they have offered compelling evidence that unprecedented changes in literacy development and practices are taking place as a result of the Internet.

Although there is still no empirical research on the effects of the Internet on emergent literacy skills development, numerous online intentional and non-intentional learning opportunities exist in the major languages of the world. A Google search reveals many intentional learning programs

(free and fee-based), as well as non-intentional programs such as games designed for young children. Many feature structured curricula and carefully designed activities for young children (e.g., Headsprout, USA; ABRACADABRA, Canada). The widespread Internet availability in developed nations means that intentional learning sites for young children hosted in these nations can contain multiple languages from developing and least-developed nations. Sesame Street Workshop recently launched Panwapa World, an international, multilingual site for young children four to seven years old that follows six characters on an island that floats around the world visiting other nations. The site offers access in English, Spanish, Chinese, Japanese, and Arabic. The International Children’s Digital Library (www.childrenslibrary.org) offers a free, online children’s literature library with hundreds of books in 53 languages and hopes to soon reach 100 languages. The goals are to inspire reading in the world’s children and to help them understand and respect diverse cultures, languages, and ideas through literature. The web site also contains theme-based activities for teachers and parents.

As discussed, many children also access emergent literacy opportunities simply by watching and listening as others use the Internet. Intentional and non-intentional Internet learning opportunities for children in developing and least-developed nations are not possible without Internet portals and access, which are increasing in number. The two largest Internet user nations are China and India, and the number of portals and access points continues to expand in other nations (Miniwatts Marketing Group, 2009; see Appendix B, C). For example, Augere is beginning low-cost, wireless, Internet penetration in Bangladesh, Pakistan, Indonesia, the Philippines, Rwanda, Uganda, and Nigeria and hopes to have one billion subscribers within five years.

Since computers of some kind are also required, a recent development of interest is the availability of low-cost computers with Internet capabilities. The One Laptop per Child (OLPC) Foundation has developed a laptop with Internet capability, the XO, that costs about US\$180 (March, 2009 figure; OLPC; also see Appendix F). The mission is to ensure that all school-age children in the world have access to a personal laptop with Internet access and to ensure free and widespread use. OLPC has worked with schools, teachers, and children in Haiti, Ethiopia, Mongolia, Afghanistan, Uruguay, Ghana, Peru, Brazil, Thailand, Nigeria, India, Sri Lanka, and Rwanda. Other efforts to develop low-cost Internet-capable computers have come from Dell, Hewlett-Packard, Lenovo, and Microsoft. Dell is marketing a US\$480 laptop and a US\$440 desktop in some twenty developing nations. As mentioned earlier, there are several Internet-capable netbook computers now available for young children. Also noteworthy is an effort by the International Telecommunications Union (ITU) called Connect the World, which uses public-private partnerships to provide low-cost laptops for children in least-developed nations. Whenever possible, the laptops are connected to the Internet through the ITU Wireless Broadband Partnership. Also, the Intel World Ahead: Connecting

The Next One Billion program has been working on accelerating connectivity to the Internet (see Appendix E; www.intel.com/intel/worldahead).

Non-profits are also venturing into the Internet service portal and access arena. In Indonesia, a non-profit business association known as APW Komitel is working to set up Warnets (cybercafes), with the goal of providing all villages with community access points by 2015. The Sustainable Access in Rural India (SARI) project aims to demonstrate that Internet access in poor rural areas can lead to improvements in health, learning, and economic development. SARI is a project of IIT-Madras, MIT Media Lab [<http://edev.media.mit.edu/SARI/>], Berkman Center for Internet and Society, Harvard University Law School, the I-Gyan Foundation, and n-Logue Communications. The pilot phase provided Internet access to roughly 1,000 connections in 350 villages in the Madurai District of Tamil Nadu, ensuring watching, listening, and non-intentional learning opportunities for many young children.

Video Games

While much has been written about the influence of video games on children and adolescents (Bailey, West, & Anderson, in press; Gee, 2008; Saloni-Pasternak & Gelfond, 2005; Squire, 2003), little has been written about the effects on young children. With the exception of a study of video game effects on first- and second-grade children in Chile, there is no research available on the influence of video games on emergent literacy skills development (Margolis, Nussbaum, Rodriguez, & Rosas, 2006; Nintendo Game Boy, ns; for reading comprehension results, see also Harris, 2004). Until recently, there were few video games intentionally designed for young children, and young children's video game usage was limited to listening, watching, and occasionally playing with their older siblings or friends. However, more and more video games are now tailored for young children, and some are targeted at emergent literacy. An Amazon search of video games for young children reveals many titles related to the development of emergent literacy skills (e.g., *Dora the Explorer*, *Blue's Clues*, *Sesame Street Elmo*, *Disney Toddler*).

Today's young children in developed and some developing nations have access to video games that can be played on a television, video/audio player, console, computer, handheld device, or a portable device such as a cell phone, Nintendo DS, or iPod Touch/iPhone. The newer technologies allow video games to be purchased or loaded at no charge by parents or older siblings as add-on applications to a mobile wireless tool. The availability of low-cost video games for children in developing and least-developed nations seems likely to continue. Nintendo has launched an aggressive marketing plan in Latin America (August, 2008) and expects that market to soon be worth US\$2 billion. A Canadian company, Synergex, announced plans in 2008 to market its value-priced video games, which are older and therefore less expensive, in Latin America in a bid to reach US\$10 million in sales.

The impact of this increased availability is unclear. It is known that video games can have both negative and positive influences on older children and adolescents (Saloni-Pasternak & Gelfond, 2005). Benefits have been documented in terms of enhanced visual attention and perceptual-motor skills development among older users (Green & Bavelier, 2004). However, negative effects from video game violence and aggression have been a contentious issue, particularly with regard to young children even if they are just watching and listening (for review, see Anderson & Bushman, 2001; Byron, 2008), although Kutner and Olson (2008) have recently suggested in their book, *Grand Theft Childhood*, that "the strong link between video game violence and real world violence, and the conclusion that video games lead to social isolation and poor interpersonal skills, are drawn from bad or irrelevant research, muddleheaded thinking and unfounded, simplistic news reports" (p. 8; see also, Chatfield, 2010 for positive effects). Despite the pros and cons, video games are ubiquitous in developed nations and rapidly becoming more common in developing and least-developed nations.

Digitized Toys

Children's play increasingly involves digital toys (Kafai & Giang, 2008). As Dyson (2009) noted, "play is where children discover ideas, experiences, and concepts and think about them and their consequences. This is where literacy and learning really begins" (np). Young children in developed nations have access to many types of digital toys, from talking animals to interactive board games and puzzles, not to mention toy laptops with learning software, working keyboards, and mice. Worldwide, the overall toy market, including digital toys, is almost US\$80 billion. Not surprisingly, with such a large market and a lack of empirical studies, controversy surrounds the impact of digital toys on young children (Johnson & Christie, 2009; Johnson, Christie, & Wardle, 2005). Some bemoan the extent to which children are drawn to digital toys and worry that the new media may contribute to a decline in children's play and opportunities for emergent literacy development (Brown, 2009; Frost, Wortham, & Reifel, 2008). Others welcome digital toys and the new possibilities that they create for play, fun, and emergent literacy skills development (Johnson & Christie, 2009).

Researchers have begun to study how young children use digital media toys as they develop emergent literacy skills. A toy developed by Ananny (2002), called TellTale, lets young children create, share, and edit oral language in a way similar to how they create written language. The toy is caterpillar-like, with five modular, colored body pieces including a head and a 20-second audiotape in each modular section. As children connect the caterpillar segments, they can create stories about the caterpillar, record them, and hear them played back. Preliminary research indicated that young children liked TellTale, and it may hold promise for supporting young children's language development through play. In another study, Bergen (2004)

investigated young children's play with talking and non-talking rescue heroes. Children were videotaped playing for 15 to 20 minutes with toys (firefighters and police) and blocked into two sessions one to two weeks apart. Children who were presented with the talking toys used language narratives that were similar to those of the children with the non-talking toys. The two groups of children did not differ from each other in their use of language and actions relevant to the themes of the pretend play. Bergen concluded that play was not stifled by the talking toys' special features (for a general historical review, see Goldstein, Buckingham, & Brougere, 2004; see also, MIT Media Lab, Lifelong Kindergarten Project, *Scratch*).

Cell Phones

In many nations of the world cell phone penetration is almost 100 percent and in some cases more than that (see Appendices B, C). Cell phone usage dominates communication in developing and least-developed nations, where the lack of infrastructure, cost, and government control has stymied the installation of landlines—and "...cell phones have probably done more to improve people's lives than perhaps any technology in history" (Kallasvuori, 2010, np). Clearly there are lots of cell phones and services available throughout the world. For example, China has more cell phone users than all of Europe (over 600 million). In India, according to India Telecom News (2009), almost 400 million people are cell phone users, including about 100 million rural Indians. Cell phones are also rapidly becoming the favored digital media in many African nations, with over 300 million users (Nixon, 2009; see Appendix B).

Young eyes and ears are watching and listening—in fact, some young children in the U.S. have already used cell phones to develop emergent literacy skills. As mentioned earlier, the U.S. Ready to Learn Initiative studied family use of cell phones to help three- and four-year-old children learn letters and the alphabet song. The study found positive results for children learning the alphabet and for parental opinions about the effort (*PBS Ready to Learn: Learning Letters with Elmo*, WestEd, 2006). More cell phone applications for young children have appeared. For example, smart phones like the iPhone (and the non-phone companion, iPod Touch) have apps for young children that support emergent literacy skills development—both for purchase and at no charge (for discussion, see Swidey, 2009). There are now hundreds of iPod Touch/iPhone apps like TickleTap (www.zincroe.com), which is designed to help young children learn about sounds, numbers, colors, patterns, and shapes. Apps have become so widespread among technology-savvy parents around the world that one reporter from India (Priyanka, 2010) has called them, perhaps tongue-in-cheek, "on-the-go pacifiers." Of course, children do not need apps to be pacified or learn from cell phones. In fact, general cell phone use by adolescents and adults almost certainly influences the world's children and affects their emergent literacy skills development (e.g.,

Armario, 2009). Nokia's Jan Chipchase, an anthropologist who studies the influence of cell phone technologies all over the world, has noted that,

No mainstream company is manufacturing and marketing phones at the three-to-six age group (for the record). There are a few niche "phones for kids" products on the market in places like Japan—but *kids tend to quickly gravitate to what their elders are using*. If their parents/siblings/extended families have one, the phone will end up being chewed/played with etc. Generally the entry/cheaper phones are more robust, more likely to survive a chewing. [It is] one of the few electronic objects that beeps/has (color) display/rings/ plays music/ [and] it is a source of fascination. Kids are likely to know every nook and cranny of the interface, are motivated to try everything out without worry of damaging or cost. Kids learn from other kids and younger boys especially fawn over the tech specs. Kids teach their parents how to use, particularly if parents are textually illiterate. Kids become the mediators of their parents' experiences e.g. sending the text message, taking the photo, changing the ring tone, etc... (Personal communication, 10/14/09, italics added)

Other anecdotal evidence includes articles on developing nations, learning, and cell phones (m-learning) in the *International Review of Research in Open and Distance Learning* (2007, Vol. 8, No. 2). It is clear that cell phones are already present in the literacy lives of young children throughout the world.

It is also interesting to note that, beyond emergent literacy, cell phone usage among young children may lead to behaviors we can only begin to imagine today. For example, online reading opportunities and the widespread availability of text messaging may promote charitable giving among young people and even lead to habits of life-long giving, at least in developed nations. The impact of digital media on charitable giving was illustrated by the outpouring of text-messaging contributions after the Haiti earthquake, and this new activity may at some point begin to impact the habits of young children.

Implications and Potential Effects

Any discussion on the effects of digital media on emergent literacy skill development, especially non-intentional (incidental) effects, can trace its origin to McLuhan (1964), Papert (1980), and John Seely Brown (2002), who believed that technology and its associated content can play a critical role in the development of children's thinking and learning—and by association, in emergent literacy.

What is known about the effects of digital media on emergent literacy skill development comes largely from empirical studies of intentional content with a structured curriculum presented either through earlier technologies (e.g., educational television, radio) or through more recent technologies (e.g., talking books, video games, computers). Investigations of non-intentional effects or incidental learning are just beginning (e.g., Calvert, 2006; cf *background media*). There are no studies documenting that content acquired through one type of media or a combination of media cannot be transferred to other types (Kendeou, Bohn-Gettler, White, & van den Broek, 2008; Linebarger & Piotrowski, 2009). However, this does not mean that differential learning effects between media, especially those that enable high degrees of interactivity, do not exist (Glaubke, 2007; see, Children & Technology Lab efforts on interactivity with young children, www.lifesci.sussex.ac.uk).

Until recently, the empirical studies of intentional learning effects have not been considered as a whole. However, this has now changed, with the U.S. Ready to Learn Initiative; the Pasnik, Strother, Schindel, Penuel, and Llorent publication, *Review of Research on Media and Young Children's Literacy* (2007); the *Children Now* review by Glaubke, *The Effects of Interactive Media on Preschoolers' Learning* (2007); and the *Bryon Review, Children and New Technologies* (2008, Department of Children, Schools and Families; UK). While this literature does not examine all forms and formats of media that young children face today, it is the best summary available and does begin to provide *prima facie* evidence, although it is generally only suggestive with regard to the effects on young children and their emergent literacy skills. The following discussion is based on this literature as well as on more recent empirical studies and chapters in *Children's Learning in the Digital World* (2008) and the *International Handbook of Children, Media and Culture* (2008); the *Handbook of Children, Media and Development* (2008); and the *Handbook of Research on New Literacies* (2008).

Most of the research indicates that the media type has less of an effect than content or intensity. But which specific factors linked to emergent literacy skills development are being affected by digital media? While each culture and context stamps its identity on emergent literacy skills development, there are some universal factors. The following sections discuss the major emergent literacy factors that have been investigated with regard to the impact of digital media. They also summarize the research findings and speculate on how non-intentional digital media may affect each factor and, ultimately, literacy.

Attention

Attention precedes and shapes the encoding, or memory formation, of information and is a complex cognitive process involving interacting neural circuitry in the brain. The attention network theory subdivides the process into three systems—orienting, selecting, and sustaining attention by using executive functioning skills to ignore distractions (Callejas, Lupianez, & Tudela, 2004; Fan, McCandliss, Fossella, Flombaum, & Posner, 2005; Posner & Petersen, 1990; Posner & Raichle, 1994). Attention is necessary for memory formation (i.e., learning) and is critical for the development of emergent literacy skills (Anderson & Lorch, 1983).

But the relationship between attention and digital media is a contentious issue. Pundits around the world have claimed that the proliferation of digital media has resulted in shortened attention spans, weakened concentration, and heightened levels of distractibility (Cornwell, 2008; Greenfield, 2008; Sigman, 2008). In short, they have claimed that digital media is bad for young children (see also, Cordes & Miller, 2000). However, studies of young children using educational television report the opposite (Glaubke, 2007). Zimmerman and Christakis (2007) reported in *Pediatrics* that television and video/DVD viewing by four- and five-year-olds was not associated with attention problems regardless of program content. One of the initial goals of *Sesame Street* forty years ago was to alert, orient, and the sustain children's attention long enough to teach them, and the success of *Sesame Street* indicates that digital media can accomplish this goal (Jordan, Schmitt, & Woodard, 2002). *Sesame Street* appears to integrate developmentally appropriate content within an auditory and visual presentation system that alerts, orients, and sustains young children's attention. But is this a reciprocal process? Does watching intentional educational programs or perhaps playing educational video games then improve young children's attention processing system? If so, what happens when they interact with media that is not intentionally educational?

Television and video game research provides a clue. These types of media activate orienting and selecting processes as direct responses to the visual and auditory features of the content. However, it is not until young children engage and sustain their attention that actual encoding, or learning, occurs (Anderson & Levin, 1976; Anderson et al 1986).

Attention orientation. New research published by University of Rochester neuroscientists C. Shawn Green and Daphne Bavelier (2007) has shown that video game playing can improve the ability of adults to detect fine detail in visual images. Similarly, preschoolers who interacted with a computer in their classroom for 20 minutes a day also increased their visual discrimination skills (Li, Atkins, & Stanton, 2006).

Attention selectivity. Research conducted by Green and Bavelier (2003) suggests that playing digital games enhances children's visual selective attention (see also, Castel, Pratt, & Drummond, 2005; Rueda 2005).

Compared with non-players, young children who played action video games increased their ability to select new targets, eliminate distractions, and track existing targets—enhancing their executive control of the attention system.

Multitasking is an interesting aspect of attention selectivity. Most of the research on this skill involves adolescents and adults and has consistently shown that digital media use can enhance divided attention or the monitoring of multiple stimuli simultaneously (e.g., Dye, Green & Bavelier, 2009; Greenfield, deWinstanley et al., 1994). However, Luckin, Connolly, Plowman, and Airey (2003) found that four- and five-year-olds could also learn to master multiple interfaces involving interactive toys that used computers to control their actions. In the past, this type of behavior may have been considered a developmental stretch for young children, but this study indicates otherwise.

Sustaining attention. Regarding this final step in the attention process, “research done for *Sesame Street* reveals that children do not actually attend to television continuously, but in bursts: they tune in just enough to get the gist and be sure it makes sense” (Prensky, 2006, p. 36). In one key experiment, half the children were shown a program in a room filled with toys and half in a room with no toys. As expected, the group with toys was distracted and watched the show only about 47 percent of the time, as opposed to 87 percent of the time in the group without toys. However, when the children were tested on how much of the show they remembered and understood, the scores were identical.

Young children quickly learn how to moderate their attention according to the comprehensibility of the content. They attend for longer periods to content they can understand than to content they find confusing (Anderson et al., 1981; Kuhl & Meltzoff, 1982; Lorch & Castle, 1997; Richards & Chronise, 2000), or content that is too adult (Schmidt, Pempek, Kirkorian, Frankenfield, & Anderson, 2008), or content that is irrelevant, such as television commercials (Schmitt, Woolf, & Anderson, 2003). Researchers have yet to document that their attention persists for longer periods when interacting with media, but the empirical studies documenting that digital media increases time on task for adolescents and adults would suggest that it does (e.g., Anderson & Pempek, 2005; Carlson, 2005; Schmidt & Vandewater, 2008; Strom & Strom, 2002; Swan et al., 2005; Ziming, 2005).

Taking the attention system as a whole, we can speculate that in developing and least-developed nations young children’s neural circuitry will adapt as it becomes increasingly surrounded by digital media, leading to more rapid development of their visual and/or auditory processing systems and cognitive flexibility. Their early ability to detect subtle differences in stimuli could perhaps be applied to emerging letter-sound knowledge, leading to literacy skills development. They could acquire meta-cognitive skills (i.e., executive attention control) at earlier ages, adjusting and assigning attentional demands to learning tasks (Luckin, DuBoulay, Yuill, Kerawalla, Pearce, & Harris, 2003).

Processing Speed

The ability to process information deeply affects emergent literacy skills (Snowling & Hulme, 2005). From phonological awareness of letters, syllables, and words to visual lexical access of words, processing speed has been implicated in literacy success (Adams, 2006; Bowey, 2005). Processing speed and accuracy build reading fluency and together are critical factors in vocabulary and comprehension development (National Institute of Child Health and Human Development, 2000). Clearly age-appropriate information processing speed is important for emergent literacy skills development.

Like the attention process, the speed of information processing in young children is under physiological constraint but also affected by experience and context (Miller & Vernon, 1997). Looking at the relationship between processing speed and digital media, Stephen, McPake, Plowman, and Berch-Heyman (2008) have found that young children are sensitive to the speed at which digital information is presented to them and respond negatively to digital media that they find too slow. At least one corporation, Scientific Learning, offers a computer-based teaching program for five-year-olds that focuses on the development of information processing speed (Fast ForWord, www.scilearn.com).

This sensitivity to information processing speed may be important, given that non-intentional information available through listening and watching older people appears at “adult” processing speeds, while intentional information such as educational television programs is presented at developmentally appropriate “child” speeds. Not surprisingly, children with older siblings tend to be exposed to more non-educational and possibly even incomprehensible “adult” content than first or only children (Calvert, 2006; Zimmerman et al., 2007).

Young children who are surrounded by “adult-speed” digital media may expect things to happen faster, with faster response and feedback times—along with faster information availability. However, they will most likely encounter slower speeds when they use educational programs specifically designed for them—or attend preschools. These children may need to make meta-cognitive adjustments to the speed of information processing depending upon the circumstances (for discussion, see Crone & Whitehurst, 1999; Fang & Cox, 1999).

It seems possible to speculate that media can affect the physiology and abilities of the information processing system parallel to what has been previously noted within the attention systems. Thus, children in developing and least-developed nations may develop abilities in speed of information processing, as well as the ability to adjust their information processing speed, at younger and younger ages.

Attitudes Toward Learning

Attitudes toward learning in general, and toward reading and writing in particular, develop early and tend to remain stable (Snow, Burns & Griffin, 1998; Westberg, Lonigan, & Molfese, 2006). Developing a positive attitude toward learning at an early age may be absolutely critical, because it affects the life-course trajectory, via a negative or positive feedback loop, on which a child is launched.

As discussed earlier, research on the effects of educational television programs has consistently shown positive results. Many researchers report that one potential reason is the overall appeal of television programs (e.g., Glaubke, 2007; Jordan, Schmitt, & Woodard, 2002; Linebarger & Piotrowski, 2006). The same is true of video and computer games that are intentionally created to be educational (Subrahnamyam, Greenfield, Kraut, & Gross, 2002; Taylor, 2006; Van Scoter, Ellis, & Railsback, 2001). Educational programs, regardless of platform (television, computer, or video game) “seduce young children with color, movement, sound, and interaction” and create interest without being too complex (Cooper, 2005, p. 286). The low level of threat builds self-confidence and a positive emotional connection with the learning experience (Lewin, 2000; Luckin, Connolly, Plowman, & Airey, 2003; Silvín-Kachala, & Bialo, 1994). For example, Linebarger (2001) found that emerging readers were motivated to read captions presented with programs and that boys in particular improved their reading fluency. Gee (as quoted in Prensky, 2006) noted that “this is a phenomenon that we see over and over again—that kids will read at a level over their head if it’s in these areas where they’ve really been turned on by these games” (p. 165).

In developing and least-developed nations, access to digital media may well supplant access to print media. Young children in these nations may learn to read and write entirely through a digital medium, facilitating emergent literacy skills development on multiple levels. Digital media not only promotes positive attitudes toward learning, it is also engaging and relatively accessible when compared with other media resources in these countries.

Social Collaboration

Social collaboration is important in the development of emergent literacy skills, often relying on the involvement of peers, siblings, or parents (Vygotsky, 1978). Research by Vygotsky and more recently by Kuhl et al. (2003, 2004), has consistently demonstrated that social interaction plays a critical role in language and literacy development, with increases in meaningful social interactions leading to increases in language and literacy learning, and that these interactions are mediated by “cultural tools.” In 1930, Vygotsky (English translation 1978; 1986) predicted that societies would constantly create new tools that would promote the emergence of higher mental functioning. Digital media can be considered cultural tools that impact cognitive development and knowledge acquisition through collaborative use and social interaction. In the same way

that shared book reading fosters interaction and leads to increased language and literacy skills (Institute of Education Sciences, 2007), digital media can stimulate social interaction to increase language and literacy, and children playing computer games have in fact shown increased levels of collaboration and communication (e.g., Clements & Sarama, 2002; Haugland & Wright, 1997).

Almost all digital games designed for three- to five-year-old children can claim to support collaboration and social interaction, leading to cognitive development, but there is a lack of empirical research to support these claims. Beyond games, however, a cornucopia of collaboration and social interaction technologies—smart phones, blogs, IM, Flickr, MySpace, Facebook, Skype, YouTube, iChat, and so on—allows young children to observe literacy skills at work within the social interaction of older peers. The effects of these observations on emerging literacy skills have yet to be determined.

Any discussion on media and social collaboration would be remiss without some mention of the longstanding debate regarding the potential effects of digital media on children’s overall social development (positive, Mares, Palmer, & Sullivan, 2008; Shimai, Masuda, & Kishimoto, 1990; and negative, American Academy of Pediatrics, 2000; Calvert, 2006). Beginning in 1976 with *Death Race*, action-violence media content has been controversial and the research disputatious (for reviews, see Buckingham et al., 2008; Gee, 2008; Gelfond & Saloni-Pasternak, 2005). The concern remains that young children may find themselves watching and listening to older people play popular computer, Internet, and video games designed to be action-packed and violent. Research has yet to document the impact of these non-intentional interactions, as well as the social interactions between younger and older children enmeshed in this type of digital environment. The Children’s Digital Media Center at Georgetown University is documenting the ways young children encode and recall information presented on a two-dimensional media platform and has found that by the age of three, children can consistently imitate an action viewed on a two-dimensional screen (Calvert & Wilson, 2008). It is possible that selective attention may prevent any negative repercussions, as found in the Schmidt et al. (2008) study in which young children ignored the adult content presented on television, preferring to play with their toys. Although children commonly ask questions about content when viewing with older peers (e.g., Alexander, Ryan, & Munoz, 1984), in the Schmidt study, the parents and children interacted minimally since the parents were engaged with the content and the children with the toys—perhaps another form of parallel play.

It is possible that in developing and least-developed nations, digital media will impact young children’s cognitive and knowledge development as it mediates social interactions and provides learning opportunities and information access (Van Scoter, 2001). As they observe others controlling and accessing information through digital media, young children may become involved in

conversations and the learning process. While they may not have access to “old-fashioned” information resources—books—they may have access to newer, more adaptive sources of information via digital media. Cell phones and solar-powered handheld computers that access books and Internet images could affect and perhaps enhance their developing understanding of the world.

Digital Literacy

Young children immersed in digital media opportunities will develop some degree of digital literacy, that is, the ability to use digital media for speaking, listening, reading, and writing purposes. But digital literacy includes not only traditional emergent literacy skills like reading and writing, but also the psycho-motor skills needed for keyboarding and cell phone use and the problem-solving skills needed for navigating Google sites and using iPhone apps. We can expect that, as literacy skills develop, so will skills in digital literacy, especially as young children become more comfortable using digital media as tools. As Resnick (2002) suggested, “When you learn to read and write, you are in a better position to learn many other things. So too with digital fluency” (p. 33). Cavallo (2000) of the M.I.T. Future of Learning group has noted, “The idea of building technological fluency draws on the image of being fluent in a language. When one is fluent in a natural language, one can think, express, communicate, imagine and create with that language. In the same way, we like to develop fluency through the construction of, and with technology as a means of, personal and group expression” (p. 771). Although there is no empirical research supporting the notion that literacy and digital literacy skills develop in tandem, previous research with computers has documented positive relationships between computer use and overall learning gains (e.g., Norris, et al., 2003).

Conclusion

This white paper begins a discussion about how digital media learning opportunities might be affecting emergent literacy skills, particularly in developing and least-developed nations.

New opportunities are impacting a generation of young children, who are approaching learning and literacy in ways not thought possible in the past, and developmental milestones are changing. As noted by Rideout et al. (2003) and Vandewater et al. (2007), these changes present a revolutionary phenomenon in child development and must be understood. Until recently, research into these changes has drawn scant attention, especially regarding children in developing and least-developed nations. But today interest is coming from governments, NGOs, foundations, universities and businesses. However, until more empirical research becomes available, it is only possible to speculate about the effects based mostly on what the research has

taught us about television and computer-based learning with older children, adolescents, and adults in developed nations. Factors that may be affected include attention, information processing speed, social collaboration, attitudes, and digital literacy.

McLuhan (1964), Papert (1980), and Brown (2002) believed that media would change the way humans learn. Taken a step further, it just may be that emergent literacy skills development is evolving to meet the needs of digital media—and this may be happening in one generation and throughout the world.

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APPENDIX A: United Nations List of Least-Developed Countries

List of Least-Developed Countries

| | | | |
|----|------------------------------------|----|-----------------------------|
| 1 | Afghanistan # | 26 | Madagascar |
| 2 | Angola | 27 | Malawi # |
| 3 | Bangladesh | 28 | Maldives * |
| 4 | Benin | 29 | Mali # |
| 5 | Bhutan # | 30 | Mauritania |
| 6 | Burkina Faso # | 31 | Mozambique |
| 7 | Burundi # | 32 | Myanmar |
| 8 | Cambodia | 33 | Nepal # |
| 9 | Cape Verde * | 34 | Niger # |
| 10 | Central African Republic # | 35 | Rwanda # |
| 11 | Chad # | 36 | Samoa * |
| 12 | Comoros * | 37 | São Tomé and Príncipe * |
| 13 | Democratic Republic of the Congo | 38 | Senegal |
| 14 | Djibouti | 39 | Sierra Leone |
| 15 | Equatorial Guinea | 40 | Solomon Islands * |
| 16 | Eritrea | 41 | Somalia |
| 17 | Ethiopia # | 42 | Sudan |
| 18 | Gambia | 43 | Timor-Leste * |
| 19 | Guinea | 44 | Togo |
| 20 | Guinea-Bissau * | 45 | Tuvalu * |
| 21 | Haiti * | 46 | Uganda # |
| 22 | Kiribati * | 47 | United Republic of Tanzania |
| 23 | Lao People's Democratic Republic # | 48 | Vanuatu * |
| 24 | Lesotho # | 49 | Yemen |
| 25 | Liberia | 50 | Zambia # |

* Also small island developing states

Also landlocked developing countries

APPENDIX B: United Nations Technology/Digital Media Infrastructure Survey

United Nations Infrastructure Data 2008 (per 100)

| | Landline Telephone Users | Cellular Users | PC Users | Internet Users | Broadcast Users |
|----------------------------|--------------------------|----------------|----------|----------------|-----------------|
| CARIBBEAN | | | | | |
| Barbados | 50 | 77 | 15 | 59 | 12 |
| Trinidad and Tobago | 25 | 126 | 10 | 12 | 2 |
| Dominican Republic | 10 | 51 | 2 | 22 | 1 |
| Bahamas | 41 | 70 | 12 | 32 | 4 |
| St. Kitts and Nevis | 59 | 24 | 26 | 24 | 1 |
| St. Lucia | 33 | 66 | 16 | 34 | 0 |
| Jamaica | 12 | 106 | 7 | 46 | 2 |
| Grenada | 27 | 46 | 16 | 19 | 3 |
| Antigua and Barbuda | 45 | 106 | 15 | 36 | 7 |
| St. Vincent and Grenadines | 19 | 74 | 14 | 8 | 5 |
| Cuba | 7 | 1 | 3 | 2 | 0 |
| Dominica | 29 | 59 | 18 | 29 | 5 |
| Haiti | 2 | 6 | 0 | 8 | 0 |

Figures rounded to whole numbers

United Nations Infrastructure Data 2008 (per 100)

| | Landline Telephone Users | Cellular Users | PC Users | Internet Users | Broadcast Users |
|------------------------|--------------------------|----------------|----------|----------------|-----------------|
| CENTRAL AMERICA | | | | | |
| Mexico | 18 | 53 | 13 | 17 | 3 |
| Costa Rica | 31 | 33 | 23 | 28 | 1 |
| El Salvador | 15 | 55 | 5 | 9 | 1 |
| Panama | 13 | 52 | 5 | 7 | 1 |
| Guatemala | 10 | 56 | 2 | 10 | 0 |
| Belize | 12 | 43 | 15 | 12 | 2 |
| Honduras | 10 | 30 | 2 | 5 | 0 |
| Nicaragua | 4 | 33 | 4 | 3 | 0 |

Figures rounded to whole numbers

United Nations Infrastructure Data 2008 (per 100)

| | Landline Telephone Users | Cellular Users | PC Users | Internet Users | Broadcast Users |
|----------------------|--------------------------|----------------|----------|----------------|-----------------|
| SOUTH AMERICA | | | | | |
| Argentina | 24 | 81 | 9 | 21 | 4 |
| Chile | 20 | 76 | 15 | 25 | 6 |
| Brazil | 21 | 53 | 16 | 23 | 3 |
| Uruguay | 28 | 67 | 14 | 22 | 3 |
| Colombia | 17 | 64 | 4 | 14 | 1 |
| Peru | 8 | 30 | 10 | 21 | 2 |
| Venezuela | 15 | 69 | 9 | 15 | 2 |
| Bolivia | 7 | 29 | 2 | 6 | 0 |
| Ecuador | 13 | 63 | 7 | 12 | 0 |
| Paraguay | 5 | 51 | 7 | 4 | 0 |
| Guyana | 15 | 37 | 4 | 21 | 0 |
| Suriname | 18 | 71 | 4 | 7 | 1 |

Figures rounded to whole numbers

United Nations Infrastructure Data 2008 (per 100)

| | Landline Telephone Users | Cellular Users | PC Users | Internet Users | Broadcast Users |
|---------------------|--------------------------|----------------|----------|----------------|-----------------|
| CENTRAL ASIA | | | | | |
| Kazakhstan | 20 | 53 | 0 | 8 | 0 |
| Kyrgyzstan | 8 | 10 | 2 | 6 | 0 |
| Uzbekistan | 6 | 3 | 3 | 6 | 0 |
| Turkmenistan | 8 | 2 | 7 | 1 | 0 |
| Tajikistan | 4 | 4 | 1 | 0 | 0 |

Figures rounded to whole numbers

United Nations Infrastructure Data 2008 (per 100)

| | Landline Telephone Users | Cellular Users | PC Users | Internet Users | Broadcast Users |
|---------------------|--------------------------|----------------|----------|----------------|-----------------|
| EASTERN ASIA | | | | | |
| Republic of Korea | 56 | 84 | 53 | 71 | 29 |
| Japan | 43 | 79 | 67 | 68 | 20 |
| China | 28 | 35 | 4 | 10 | 4 |
| Mongolia | 6 | 21 | 13 | 10 | 0 |
| Dem People's Korea | 4 | 0 | 0 | 0 | 0 |

Figures rounded to whole numbers

United Nations Infrastructure Data 2008 (per 100)

| | Landline Telephone Users | Cellular Users | PC Users | Internet Users | Broadcast Users |
|----------------------|--------------------------|----------------|----------|----------------|-----------------|
| SOUTHERN ASIA | | | | | |
| Maldives | 11 | 88 | 15 | 7 | 2 |
| Sri Lanka | 9 | 26 | 4 | 2 | 0 |
| Iran | 31 | 19 | 11 | 26 | 1 |
| India | 4 | 15 | 2 | 5 | 0 |
| Pakistan | 3 | 22 | 1 | 8 | 0 |
| Bhutan | 4 | 5 | 2 | 3 | 0 |
| Bangladesh | 1 | 13 | 2 | 0 | 0 |
| Nepal | 2 | 4 | 0 | 1 | 0 |
| Afghanistan | 1 | 8 | 0 | 2 | 0 |

Figures rounded to whole numbers

United Nations Infrastructure Data 2008 (per 100)

| | Landline Telephone Users | Cellular Users | PC Users | Internet Users | Broadcast Users |
|---------------------------|--------------------------|----------------|----------|----------------|-----------------|
| SOUTH-EASTERN ASIA | | | | | |
| Singapore | 42 | 109 | 68 | 39 | 18 |
| Malaysia | 17 | 75 | 22 | 44 | 3 |
| Thailand | 11 | 63 | 7 | 13 | 0 |
| Philippines | 4 | 51 | 5 | 5 | 0 |
| Brunei Darussalam | 21 | 67 | 9 | 43 | 1 |
| Viet Nam | 19 | 18 | 1 | 17 | 1 |
| Indonesia | 7 | 28 | 2 | 7 | 0 |
| Cambodia | 0 | 8 | 0 | 0 | 0 |
| Myanmar | 1 | 0 | 1 | 0 | 0 |
| Timor-Leste | 0 | 5 | 0 | 0 | 0 |
| Lao People's Republic | 8 | 10 | 0 | 6 | 0 |

Figures rounded to whole numbers

United Nations Infrastructure Data 2008 (per 100)

| | Landline Telephone Users | Cellular Users | PC Users | Internet Users | Broadcast Users |
|---------------------|--------------------------|----------------|----------|----------------|-----------------|
| WESTERN ASIA | | | | | |
| Israel | 44 | 123 | 73 | 28 | 21 |
| UAE | 28 | 118 | 23 | 37 | 5 |
| Cyprus | 49 | 92 | 33 | 42 | 6 |
| Bahrain | 26 | 122 | 18 | 21 | 5 |
| Jordan | 11 | 74 | 6 | 14 | 1 |
| Qatar | 27 | 110 | 19 | 35 | 6 |
| Kuwait | 19 | 89 | 22 | 30 | 1 |
| Saudi Arabia | 15 | 78 | 13 | 19 | 1 |
| Lebanon | 19 | 31 | 11 | 26 | 5 |
| Turkey | 25 | 71 | 6 | 17 | 4 |
| Oman | 11 | 70 | 5 | 12 | 1 |
| Azerbaijan | 14 | 39 | 2 | 10 | 0 |
| Georgia | 12 | 38 | 5 | 7 | 1 |
| Armenia | 20 | 11 | 10 | 6 | 0 |
| Syria | 17 | 24 | 4 | 8 | 0 |
| Iraq | 4 | 2 | 1 | 0 | 0 |
| Yemen | 5 | 10 | 2 | 1 | 0 |

Figures rounded to whole numbers

United Nations Infrastructure Data 2008 (per 100)

| | Landline Telephone Users | Cellular Users | PC Users | Internet Users | Broadcast Users |
|-----------------------|--------------------------|----------------|----------|----------------|-----------------|
| EASTERN EUROPE | | | | | |
| Czech Republic | 31 | 119 | 27 | 35 | 11 |
| Hungary | 33 | 99 | 15 | 35 | 10 |
| Poland | 30 | 95 | 24 | 29 | 7 |
| Slovakia | 22 | 91 | 36 | 42 | 6 |
| Ukraine | 27 | 107 | 5 | 12 | n/a |
| Bulgaria | 31 | 108 | 6 | 24 | 5 |
| Romania | 19 | 80 | 13 | 32 | 8 |
| Belarus | 35 | 61 | 1 | 56 | 0 |
| Russian Federation | 28 | 84 | 12 | 18 | 2 |
| Republic of Moldova | 24 | 32 | 8 | 17 | 1 |

Figures rounded to whole numbers

United Nations Infrastructure Data 2008 (per 100)

| | Landline Telephone Users | Cellular Users | PC Users | Internet Users | Broadcast Users |
|------------------|--------------------------|----------------|----------|----------------|-----------------|
| OCEANIA | | | | | |
| Australia | 49 | 97 | 77 | 75 | 19 |
| New Zealand | 43 | 88 | 52 | 79 | 14 |
| Fiji | 13 | 24 | 6 | 9 | 1 |
| Tonga | 14 | 30 | 6 | 3 | 1 |
| Samoa | 11 | 13 | 2 | 4 | 0 |
| Vanuatu | 3 | 6 | 1 | 3 | 0 |
| Papua New Guinea | 1 | 1 | 7 | 2 | 0 |

Figures rounded to whole numbers

No data on Kiribati, Marshall Islands, Micronesia, Nauru, Palau, Tuvalu

United Nations Infrastructure Data 2008 (per 100)

| | Landline Telephone Users | Cellular Users | PC Users | Internet Users | Broadcast Users |
|--------------------------|--------------------------|----------------|----------|----------------|-----------------|
| CENTRAL AFRICA | | | | | |
| Angola | 1 | 14 | 1 | 1 | 0 |
| Gabon | 3 | 54 | 3 | 6 | 0 |
| Sao Tome and Principe | 5 | 12 | 4 | 18 | 0 |
| Equatorial Guinea | 2 | 19 | 2 | 2 | 0 |
| Congo | 0 | 12 | 0 | 2 | 0 |
| Cameroon | 1 | 14 | 1 | 2 | 0 |
| Dem. Republic of Congo | 0 | 7 | 0 | 0 | 0 |
| Central African Republic | 0 | 2 | 0 | 0 | 0 |
| Chad | 0 | 5 | 0 | 1 | 0 |

Figures rounded to whole numbers

United Nations Infrastructure Data 2008 (per 100)

| | Landline Telephone Users | Cellular Users | PC Users | Internet Users | Broadcast Users |
|-----------------------------|--------------------------|----------------|----------|----------------|-----------------|
| EASTERN AFRICA | | | | | |
| Mauritius | 28 | 62 | 17 | 23 | 2 |
| Seychelles | 25 | 85 | 20 | 36 | 2 |
| Kenya | 1 | 18 | 1 | 8 | 0 |
| Uganda | 0 | 7 | 2 | 3 | 0 |
| Madagascar | 1 | 5 | 1 | 1 | 0 |
| Zimbabwe | 3 | 6 | 7 | 9 | 0 |
| Rwanda | 0 | 3 | 0 | 1 | 0 |
| United Republic of Tanzania | 0 | 15 | 1 | 1 | n/a |
| Malawi | 1 | 3 | 0 | 0 | 0 |
| Mozambique | 4 | 52 | 2 | 20 | 1 |
| Djibouti | 2 | 6 | 3 | 1 | 0 |
| Zambia | 1 | 14 | 1 | 4 | 0 |
| Eritrea | 1 | 1 | 1 | 2 | 0 |
| Comoros | 2 | 2 | 1 | 3 | 0 |
| Ethiopia | 1 | 1 | 0 | 0 | 0 |
| Burundi | 0 | 2 | 1 | 1 | 0 |
| Somalia | n/a | n/a | n/a | n/a | n/a |

Figures rounded to whole numbers

United Nations Infrastructure Data 2008 (per 100)

| | Landline Telephone Users | Cellular Users | PC Users | Internet Users | Broadcast Users |
|---------------------|--------------------------|----------------|----------|----------------|-----------------|
| NORTH AFRICA | | | | | |
| Egypt | 14 | 24 | 4 | 8 | 0 |
| Libya | 8 | 66 | 2 | 4 | 0 |
| Algeria | 9 | 63 | 1 | 7 | 0 |
| Tunisia | 12 | 72 | 6 | 13 | 0 |
| Morocco | 4 | 52 | 2 | 20 | 0 |
| Sudan | 2 | 13 | 11 | 9 | 0 |

Figures rounded to whole numbers

United Nations Infrastructure Data 2008 (per 100)

| | Landline Telephone Users | Cellular Users | PC Users | Internet Users | Broadcast Users |
|------------------------|--------------------------|----------------|----------|----------------|-----------------|
| SOUTHERN AFRICA | | | | | |
| South Africa | 10 | 83 | 8 | 11 | 0 |
| Lesotho | 3 | 14 | 0 | 3 | 0 |
| Botswana | 8 | 56 | 5 | 3 | 0 |
| Swaziland | 4 | 24 | 4 | 4 | 0 |
| Nambia | 7 | 24 | 12 | 4 | 0 |

Figures rounded to whole numbers

United Nations Infrastructure Data 2008 (per 100)

| | Landline Telephone Users | Cellular Users | PC Users | Internet Users | Broadcast Users |
|--------------------|--------------------------|----------------|----------|----------------|-----------------|
| WEST AFRICA | | | | | |
| Cape Verde | 14 | 21 | 12 | 6 | 0 |
| Nigeria | 1 | 24 | 1 | 6 | 0 |
| Ghana | 2 | 23 | 1 | 3 | 0 |
| Senegal | 2 | 25 | 2 | 5 | 0 |
| Gambia | 3 | 26 | 2 | 4 | 0 |
| Togo | 1 | 11 | 4 | 5 | 0 |
| Liberia | 0 | 5 | n/a | 0 | 0 |
| Mauritania | 1 | 34 | 3 | 3 | 0 |
| Benin | 1 | 12 | 0 | 8 | 0 |
| Cote d'Ivoire | 1 | 22 | 2 | 2 | 0 |
| Mali | 1 | 11 | 0 | 1 | 0 |
| Burkina Faso | 1 | 7 | 0 | 1 | 0 |
| Guinea-Bissau | 1 | 7 | 0 | 2 | 0 |
| Sierra Leone | 0 | 2 | n/a | 0 | 0 |
| Guinea | 0 | 2 | 1 | 1 | 0 |
| Niger | 0 | 2 | 0 | 0 | 0 |

Figures rounded to whole numbers

Source: United Nations e-Government Survey. (2008). Department of Economic and Social Affairs, Division for Public Administration and Development Management. New York: United Nations Publication. (The source for the Survey data was the United Nations International Telecommunication Union (ITU).)

APPENDIX C: Demographics and Digital Media Survey Data for Selected Developing and Least-Developed Nations

| Country | Population (Millions) | Children < 15 + % Total Population | Number TV Stations | TV Sets per 100 people | Internet Users (Millions) + % Total Population |
|--------------|-----------------------|------------------------------------|--------------------|------------------------|--|
| Mexico | 110 | 32.5 (30%) | 457 | 24 | 22.8 (20%) |
| Guatemala | 13 | 5.2 (40%) | 26 | 11 | 1.3 (10%) |
| Honduras | 7.6 | 3 (39%) | 11 | 8 | .345 (4.5%) |
| Nicaragua | 6 | 2 (35%) | 3 | 6 | .155 (3%) |
| El Salvador | 7 | 2.5 (36%) | 5 | 9 | .700 (10%) |
| Ecuador | 14 | 4.5 (32%) | 7 | 19 | 1.5 (10%) |
| Bolivia | 9 | 3 (33%) | 48 | 10 | 1 (11%) |
| Brazil | 196 | 53 (27%) | 138 | 20 | 50 (25%) |
| Morocco | 34 | 10.5 (30.5%) | 3 | 9 | 7 (21%) |
| Turkey | 72 | 17.5 (24%) | 635 | 30 | 13.15 (18%) |
| Pakistan | 173 | 66 (38%) | 20 | 2 | 17.5 (10%) |
| India | 1100 | 361 (31%) | 562 | 6 | 80 (7%) |
| Sri Lanka | 21 | 5 (24%) | 14 | 8 | 8 (4%) |
| Nepal | 30 | 11 (38%) | 7 | 13 | .377 (1%) |
| Bangladesh | 153 | 51 (33%) | 15 | 1 | .500 (0.3%) |
| Vietnam | 86 | 22 (26%) | 67 | 4 | 18 (21%) |
| Thailand | 65 | 14 (21%) | 111 | 24 | 13 (20%) |
| Malaysia | 25 | 8 (32%) | 88 | 45 | 16 (63%) |
| Cambodia | 14 | 5 (33%) | 9 | 1 | .07 (0.5%) |
| Philippines | 96 | 34 (36%) | 250 | 4 | 5 (6%) |
| Senegal | 13 | 5.3 (42%) | 4 | 3 | .820 (6%) |
| Burkina Faso | 15 | 7 (46%) | 4 | 10 | .08 (0.5%) |
| Ghana | 23 | 7 (38%) | 9 | 7 | .65 (3%) |
| Benin | 8.5 | 4 (45%) | 6 | 9 | .15 (2%) |
| Nigeria | 146 | 51 (42%) | 93 | 5 | 10 (7%) |
| D.R. Congo | 66.5 | 31 (47%) | 5 | 11 | .23 (0.3%) |
| Angola | 12.5 | 5.5 (44%) | 1 | 2 | .10 (0.8%) |
| Mozambique | 21 | 6.5 (45%) | 6 | 1 | .20 (0.9%) |
| Malawi | 14 | 6.4 (46%) | 1 | 1 | .14 (1%) |
| Namibia | 2 | .77 (37%) | 2 | 3 | .10 (0.5%) |

Source: Kids' News Network 2008

APPENDIX D: Aga Khan Development Network

Few NGOs are doing more to support young children in developing and least-developed nations than the Aga Khan Education Services (AKES, an agency of The Aga Khan Development Network, AKDN). AKES currently operates more than 300 schools that provide pre-school, primary, secondary, and higher secondary education services to children in Pakistan, India, Bangladesh, Kenya, Uganda, Tanzania, and Tajikistan. Two programs demonstrate the interest of AKES in early childhood education. One is the *jailoo* kindergartens in the Kyrgyz Republic. “When the Aga Khan Foundation learned that many rural Kyrgyz children were missing out on kindergarten during the annual migration to the *jailoo*, or high pastures, for four to five months a year, it supported a program to bring early childhood education to the mountains. The summer migration to the *jailoo* follows a tradition that dates back over 2,500 years – a tradition that was only interrupted during the Soviet era. To bring structured, active, and enjoyable learning opportunities to the *jailoo*, AKDN supports a system of linked central and satellite kindergartens. Many of the satellite kindergartens operate in village homes during the winter and in yurts (nomadic tents) during the summer pasturage. The yurt kindergartens have been exceptionally popular. In response to demand, the teachers have started organizing activities

for older children and have also set up small libraries in yurts that cater to children from two to 14 years old. The concept has since expanded to other villages and summer pastures,” http://www.akdn.org/akf_education_jailoo.asp; np. paraphrase). AKES surveys indicate that when children from the *jailoo* kindergarten program enter primary school, they outperform other children in reading and mathematics.

The second program is the *Madrassa Early Childhood Program*, which grew out of a 1982 meeting between the Aga Khan and the Ummah leadership in Mombasa, Kenya. Since then, the program “has grown to include 203 pre-schools, with nearly 800 teachers, reaching some 30,000 households and serving more than 54,000 children” (Madrassa, 2008, p.6). The program is now operating in Tanzania, Kenya, and Uganda. AKES evidence shows that the Madrasa program is having a significant effect on early childhood development: “A regional impact study (1999-2005), which drew upon external technical assistance from researchers at Oxford University, as well as others, found that the quality of the teaching and learning environment in Madrasa preschools was higher than in non-Madrassa pre-schools, and that the quality of the pre-school environment promoted children’s cognitive development” (p.47).

| TANZANIA | KENYA | UGANDA |
|------------------------|------------------------|---------------------------|
| Established in 1990 | Established in 1989 | Established in 1993 |
| 84 pre-schools | 66 pre-schools | 53 pre-schools |
| 24,123 students | 25,204 students | 18,589 students benefited |
| 1,880 teachers trained | 2,021 teachers trained | 599 teachers trained |

Source: The Madrasa Early Childhood Programme: 25 Years of Experience 2008, p.7

APPENDIX E: World Ahead: Connecting the Next One Billion Program (Intel)

In 2005, Intel began using Intel technology to provide solutions to local problems in developing and least-developed nations. The company opened “platform definition centers” in India, Egypt, Brazil, and China to gather information and develop computing platforms based on local conditions, with a focus on e-learning environments. Intel began the e-learning program in 2006 using information compiled by staff at its platform definition centers along with its Classmate PC, a low-cost laptop for children built with the needs of developing and least-developed nations in mind.

(http://download.intel.com/intel/worldahead/pdf/classmatepc_productbrief.pdf, np).

To date, the Classmate PC is being deployed in more than 30 countries, and Intel has donated 100,000 PCs to developing and least-developed nations worldwide (World Ahead web site). The program also helps teachers to be more effective educators through professional development (Intel Teach Program) that focuses on how to integrate technology into the classroom. According to Intel, six million teachers have been trained in over 50 countries. The program also works to improve access issues in remote areas (e.g., China, Mexico, Morocco, Cameroon, Jordan, Brazil, Romania, Turkey, Lesotho, Ghana, Malaysia, Nigeria, and many others). A summary of the program’s efforts, which could affect millions of children, is available at <http://worldahead.com>.

APPENDIX F: One Laptop per Child Foundation

One Laptop per Child (OLPC) is a non-profit organization founded by Nicholas Negroponte with an ambitious mission: “To create educational opportunities for the world’s poorest children by providing each child with a rugged, low-cost, low-power, connected laptop with content and software designed for collaborative, joyful, self-empowered learning. When children have access to this type of tool they get engaged in their own education. They learn, share, create, and collaborate, they become connected to each other, to the world and to a brighter future” (<http://laptop.org/en/vision/index.shtml>, np). Negroponte’s ultimate goal is reflected in the name of his organization.

OLPC’s groundbreaking laptop, XO, is a small machine with a big mission. The XO is a potent learning tool designed and built especially for children living in some of the most remote environments in developing countries. It is about the size of a small textbook. It has built-in wireless and a unique screen that is readable under direct sunlight for children who go to school outdoors. It is extremely durable, brilliantly functional, energy-efficient, and fun (the fun starts with the bright green color of each machine), <http://laptop.org/en/laptop/index.shtml>, np. Additionally, the machine features a splash-proof keyboard and antenna that allow it to receive wireless signals from up to one kilometer away. Using open-source software wherever possible and working to design the simplest, most comprehensive alternatives when needed, OLPC has made a machine that is intended to enhance the learning experience and break barriers that hinder children living

in developing and least developed nations. OLPC works to keep the price as low as possible. The original goal was to keep the cost at US\$100. Although that has not proven possible to date (York, 2009), the XO is still one of the lowest-priced children’s laptops available.

A Uruguayan teacher with 30 years’ experience had considered retirement but changed her mind after two days of using the XO and asked for a late retirement. Peru has ordered 2.2 million XOs, with 350,000 delivered, mostly to children in very remote parts of the country. 900,000 XOs have been delivered to children in 31 countries, with 230,000 en route and 600,000 more on order. The XO has been configured for 19 languages to date. Negroponte has noted that “50 percent of Peruvian children who have XO laptops teach their parents how to read and write,” adding, “if that doesn’t give you goose bumps, I don’t know what will.” And the laptops’ benefits often go far beyond education: “When a child opened the laptop at home, it [could be] the brightest light source,” (Negroponte, qtd. in Yeo, 17 July 2009, np).

Rwanda has launched a Global Center for Excellence in Laptops and Learning to create the highest quality examples of learning with connected laptops in schools and communities, support ongoing laptop implementation plans, and create an African regional laptop network. The government has committed to providing all 2.2 million of its primary school children with laptops by 2012. (For commentary on current OLPC challenges, see York, 2009.)